PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-162338
(43)Date of publication of application : 19.06.1998

(51)Int.CI. G11B 5/66
C23C 14/14

(21)Application number : 08-318937
(22)Date of filing : 29.11.1996

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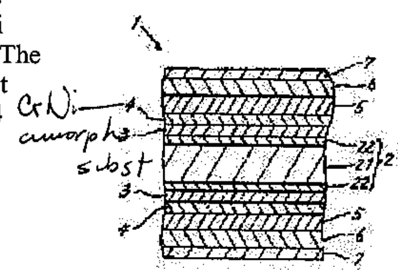
(54) METALLIC THIN FILM TYPE MAGNETIC RECORDING MEDIUM

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a metallic thin film type magnetic recording medium capable of attaining higher coercive force and lower medium noise than a metallic thin film type magnetic recording medium obtd. by forming an amorphous or crystalline layer as a single layer between each face of a substrate and an underlayer.
SOLUTION: An amorphous layer 3 of a Cr alloy and a crystalline layer 4 of a Cr-Ni alloy are laminated between each face of a medium substrate 2 and an underlayer 5. The amorphous layer 3 may have a compsn. consisting of 30-60at.% Ni, 4-10at.% at least one among W, Mo, Ta and Nb and the balance essentially Cr. The crystalline layer 4 may have a compsn. consisting of 36-46at.% Ni and the balance essentially Cr.



LEGAL STATUS
[Date of request for examination]
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] In metal thin film mold magnetic-recording data medium which comes to carry out laminating membrane formation of a substrate layer (5), a magnetic layer (6), and the protective coat (7) on a nonmagnetic data-medium substrate (2) one by one Metal thin film mold magnetic-recording data medium characterized by amorphous layer (3) of Cr alloy, and carrying out the double product layer of the crystalline substance layer (4) of a Cr-nickel alloy on it between a data-medium substrate (2) and a substrate layer (5).
[Claim 2] An amorphous layer (3) of Cr alloy is metal thin film mold magnetic-recording data medium according to claim 1 characterized by becoming a remainder real target from Cr 4 to 10% with the total quantity about at least one sort in W, Mo, Ta, and Nb nickel:30-60% in atomic %.
[Claim 3] An amorphous layer (3) of Cr alloy is metal thin film mold magnetic-recording data medium according to claim 1 characterized by becoming a remainder real target from Cr nickel:30-60% and N:20% or less in atomic %.
[Claim 4] An amorphous layer (3) of Cr alloy is metal thin film mold magnetic-recording data medium according to claim 1 characterized by becoming a remainder real target from Cr 10% or less with the total quantity about at least one sort in W, Mo, Ta, and Nb nickel:30-60% and N:20% or less in atomic %.
[Claim 5] An amorphous layer (3) of Cr alloy is metal thin film mold magnetic-recording data medium according to claim 1 characterized by becoming a remainder real target from Cr 12 to 40% with the total quantity about at least one sort of Ta and Nb in atomic %.
[Claim 6] An amorphous layer (3) of Cr alloy is metal thin film mold magnetic-recording data medium according to claim 1 characterized by becoming a remainder real target from Cr 10 - 40%, and N:20% or less with the total quantity about at least one sort of Ta and Nb in atomic %.
[Claim 7] A crystalline substance layer (4) of a Cr-nickel alloy is metal thin film mold magnetic-recording data medium given in any of claim 1 characterized by becoming a remainder real target from Cr nickel:36-46% in atomic % thru/or claim 6 they are.
[Claim 8] A crystalline substance layer (4) of a Cr-nickel alloy is metal thin film mold magnetic-recording data medium given in any of claim 1 characterized by becoming a remainder real target from Cr 0.5 to 3% with the total quantity about at least one sort in W, Mo, Ta, and Nb nickel:36-46% in atomic % thru/or claim 6 they are.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] More specifically, this invention relates to metal thin film mold magnetic-recording data medium excellent in magnetic properties and record reproducing characteristics about magnetic-recording data medium used for magnetic disk drives, such as a hard disk.
[0002]
[Description of the Prior Art] Metal thin film mold magnetic-recording data medium (1) used for a hard disk As shown in drawing 5 , to the data-medium substrate (2) with which the amorphous NiP layer (22) was generally formed on the nonmagnetic substrate (21) which consists of an aluminum alloy The membrane formation laminating of the protective coats (7) which consist of a substrate layer (5) which consists of Cr substantially, a Co-Cr alloy, etc., such as a magnetic layer (6) and carbon, is carried out to order, and it is formed. In drawing 5 , the NiP layer (22), the substrate layer (5), the magnetic layer (6), and the protective coat (7) are prepared in both sides of a substrate (21). metal thin film mold magnetic-recording data medium -- improvement in recording density, i.e., track recording density, and track density, and record -- improvement in resolution is desired, and in order to raise these, the improvement in magnetic properties (especially raise in coercive force) and the improvement in record reproducing characteristics (especially reduction in a noise) are demanded.
[0003]
[Problem(s) to be Solved by the Invention] a nonlinear wave interference unremovable [with linearity equivalence] if the track recording density of magnetic-recording data medium is raised -- being generated -- record -- it becomes the cause of deterioration of resolution. The orientation which increases, so that the magnetic anisotropy of a circumferencial direction becomes large has this nonlinear wave interference. Very much becomes important [data-medium noise reduction with the truck edge occupied on the whole truck] for improvement in track density. The increment in the data-medium noise in a truck edge originates in the magnetic anisotropy of a circumferencial direction. Moreover, a texture may be given to the surface of a data-medium substrate by putting structural creativity on magnetic-recording data medium as a means which raises coercive force. This texture forms irregularity with the minute field roughness of 50-100A of granularity in the circumferencial direction of a NiP layer with a wrapping tape or a loose grain. If a texture is given to a NiP layer, since the magnetic anisotropy of the hoop direction of Co alloy magnetic layer can be raised, it is effective in improvement in coercive force. However, the improvement in the magnetic anisotropy of a circumferencial direction leads to the increment in the data-medium noise in a truck edge as above-mentioned. The minute irregularity by the texture is effective also in mitigation of friction with magnetic-recording data medium and the magnetic head. However, in order to form an abnormality projection in the data-medium substrate surface of texture processing, or for the display flatness of a data-medium substrate to get worse and to avoid contact to an arm head and magnetic-recording data medium, the flying height of an arm head must be enlarged, a glide property gets worse, and the fall of recording density may be caused. Moreover, a scratch etc. is formed of texture processing and it may become the cause of error generating. for this reason, recently, in order that the field roughness demanded might raise reduction of the error defect which tends to become small and originates in a substrate, stable transit of the arm head in a low surfacing region, and the display flatness of a data-medium substrate, super finish processing was performed to the data-medium substrate -- there is overly also a request of a smooth data-medium substrate. However, although the magnetic anisotropy of the circumferencial direction of a magnetic layer will be lost if formation of a texture is omitted, there is un-arranging [which cannot acquire desired coercive force]. Although it is effective in Co alloy of a magnetic layer to add Pt, addition of Pt has that the target of a sputtering system becomes expensive, and the problem to which a data-medium noise becomes large further in improvement in coercive force.
[0004] Then, the applicant has proposed metal thin film mold magnetic-recording data medium (1) which formed the amorphous layer (3) or crystalline substance layer (4) which makes Cr a subject by the monolayer between the NiP layer (22) of a substrate (2), and the substrate layer (5), as shown in drawing 4 . It is checked that metal thin film mold magnetic-recording data medium which prepared the amorphous layer (3) or crystalline substance layer (4) of a monolayer has high coercive force compared with metal thin film mold magnetic-recording data medium which is not equipped with these layers, and a data-medium noise is also small.
[0005] The purpose of this invention is offering metal thin film mold magnetic-recording data medium which can attain reduction of the further raise in coercive force and the further data-medium noise rather than metal thin film mold magnetic-recording data medium which formed the above-mentioned amorphous layer or the crystalline substance layer by the

monolayer between the substrate and the substrate layer.
[0006]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, metal thin film mold magnetic-recording data medium of this invention carries out the double product layer of the crystalline substance layer (4) of a Cr-nickel alloy to an amorphous layer (3) of Cr alloy on it between a data-medium substrate (2) and a substrate layer (5).
[0007] As a constituent of an amorphous layer (3) of Cr alloy, a presentation which becomes a remainder real target from Cr 4 to 10% about at least one sort in W, Mo, Ta, and Nb at the total quantity can be mentioned nickel:30-60% for example, in atomic %. A constituent of an amorphous layer (3) of Cr alloy can also be considered as a presentation which becomes a remainder real target from Cr nickel:30-60% and N:20% or less in atomic %. Moreover, a constituent of an amorphous layer (3) of Cr alloy can also consider at least one sort in W, Mo, Ta, and Nb as a presentation which becomes a remainder real target from Cr 10% or less with the total quantity nickel:30-60% and N:20% or less in atomic %. Furthermore, a constituent of an amorphous layer (3) of Cr alloy is good at atomic % also as a presentation which becomes a remainder real target from Cr 12 to 40% with the total quantity about at least one sort of Ta and Nb. Furthermore, a constituent of an amorphous layer (3) of Cr alloy is good at atomic % also as a presentation which becomes a remainder real target from Cr 10 - 40%, and N:20% or less with the total quantity about at least one sort of Ta and Nb.
[0008] A constituent of a crystalline substance layer (4) of a Cr-nickel alloy can be considered as a presentation which becomes a remainder real target from Cr nickel:36-46% in atomic %. Moreover, a constituent of a crystalline substance layer (4) of a Cr-nickel alloy is good nickel:36-46% at atomic % also as a presentation which becomes a remainder real target from Cr 0.5 to 3% with the total quantity about at least one sort in W, Mo, Ta, and Nb.
[0009]
[Function and Effect] Between a substrate (2) and a substrate layer (5), the amorphous layer (3) of Cr alloy, and by carrying out the double product layer of the crystalline substance layer (4) of a Cr-nickel alloy on it Crystal orientation of Co alloy magnetic layer (6) which can make crystal orientation of Cr substrate layer (5) formed on it (110)+ (211) orientation, as a result is formed on this substrate layer (5) can be made into orientation (100). Moreover, the crystal of Cr substrate layer (5) is made detailed, as a result the crystal of Co alloy magnetic layer (6) is made detailed. Thus, the crystal orientation of Co alloy magnetic layer (6) improves, and a raise in the coercive force of magnetic-recording data medium and reduction-ization of a data-medium noise are attained by coincidence by making a crystal detailed. In addition, by having carried out the laminating of an amorphous layer (3) and the crystalline substance layer (4) to the duplex, the segregation to the grain boundary of Cr in the inside of a magnetic layer (6) is promoted, the magnetic interaction between magnetic grains decreases and magnetic isolation of a magnetic grain is promoted more. Thereby, reduction of the further data-medium noise can be aimed at.
[0010] Metal thin film mold magnetic-recording data medium of this invention can realize high coercive force and a low data-medium noise rather than metal thin film mold magnetic-recording data medium which prepared the amorphous layer (3) or the crystalline substance layer (4) by the monolayer as the example mentioned later compares.
[0011]
[Embodiment of the Invention] Drawing 1 shows the fragmentary sectional view of metal thin film mold magnetic-recording data medium (1) of this invention, and is carrying out laminating membrane formation of an amorphous layer (3) and crystalline substance layer (4), a substrate layer (5), a magnetic layer (6), and the protective coat (7) in this sequence on the data-medium substrate (2) which consists of aluminum alloy / a NiP substrate, or glass. In drawing 1 , the NiP layer (22), amorphous layer (3), and crystalline substance layer (4), the substrate layer (5), the magnetic layer (6), and the protective coat (7) are formed by symmetry about the substrate (21).
[0012] A texture may be given to a circumferencial direction in order to mitigate friction between an arm head and data medium in the NiP layer (22) of a data-medium substrate (2). On the other hand, when display flatness is required of magnetic-recording data medium (1) for the reduction in surfacing of an arm head, super finish processing can be performed and the surface can be made to super-graduate.
[0013] In addition, when using glass as a material of the substrate (21) of a data-medium substrate (2), since glass is excellent in rigidity, formation of a NiP layer (22) may be omitted. In this case, what is necessary is just to form an amorphous layer (3) directly on a glass substrate (21).
[0014] The thickness of an amorphous layer (3) and a crystalline substance layer (4) has desirable about 100-1000A respectively. As for the sum total thickness of these layers (3) and (4), it is more desirable to consider as the range of 600-1000A. if the thickness of an amorphous layer (3) and a crystalline substance layer (4) is too thin, the effect of these each class (3) and (4) will not fully be demonstrated, but if it becomes not much thick too much, it will be formed on it -- it is because there is a possibility that big and rough-ization of the particle of Cr substrate layer (5) and Co alloy magnetic layer (6) may be caused, and a noise may increase. Moreover, the thickness of Cr substrate layer (5) formed on a crystalline substance layer (4) has desirable 200-1000A, and its 400-800A is more desirable. Even if this makes thickness of a substrate layer (5) thicker than about 800A, further improvement in the coercive force of magnetic-recording data medium (1) is because it is not expectable, and when it is made thicker than 1000A, it is because there is a possibility that big and rough-ization of the particle of Co alloy magnetic layer (6) formed on it may be caused, and a noise may increase.
[0015] A substrate layer (5) is substantially formed from Cr so that it may be well-known. What is necessary is not to be necessarily Cr 100% in Cr, and just to contain Cr more than about 95 atom % substantially. A magnetic layer (6) forms Co from well-known Co alloy used as a principal component.
[0016] Formation of a NiP layer (22), a substrate layer (5), a magnetic layer (6), and a protective coat (7) can be performed by

methods, such as the DC sputtering method, plating, or a vacuum deposition method, so that it may be well-known.
[0017] In addition, in case an amorphous layer (3) and crystalline substance layer (4) and a substrate layer (5) are formed, in order to consider as the crystal orientation of a request of Cr substrate layer (5), it is desirable to carry out, where a substrate (2) is heated at about 250-300 degrees C at an infrared heater etc.
[0018]
[Example] Metal thin film mold magnetic-recording data-medium No.1-No.5 of this invention which carried out laminating membrane formation of both an amorphous layer (3) and the crystalline substance layer (4) between the substrate (2) and the substrate layer (5), Metal thin film mold magnetic-recording data-medium No.11 which formed either the amorphous layer (3) or the crystalline substance layer (4), and No.12 were produced, and the magnetic interaction between coercive force Hc, record reproducing characteristics, and Co magnetic particle of a magnetic layer was measured (deltaM measurement). The production conditions of sample offering magnetic-recording data medium are as follows.
- Data-medium substrate Substrate: Product made from aluminum alloy (3.5 inch-31.5mil)
A NiP layer : 10 micrometers in thickness Surface treatment : Mechanical texture of a circumferencial direction Granularity : Ra=2A and, an amorphous layer, a crystalline substance layer, a substrate layer, a magnetic layer, and protective coat Sputtering system : DC magnetron sputtering equipment Substrate temperature : 240 degree C Substrate bias voltage: -100V (at the time of an amorphous layer and crystalline substance layer membrane formation) -200V (at the time of a substrate layer and magnetic layer membrane formation) A component and thickness : Table 1 reference. (The inside of the parenthesis in a table 1 shows the thickness of each class)
[0019]
[A table 1]

No	非晶質層	結晶質層	下地層	磁性層	保護膜
1	Cr57Ni39Mo4 (400Å)	Cr58Ni40W2 (400Å)	Cr (600Å)	Co83.5Cr10.5Ta6 (250Å)	C (120Å)
2	Cr51Ni40N9 (400Å)	Cr60Ni40 (400Å)	Cr (600Å)	Co83.5Cr10.5Ta6 (250Å)	C (120Å)
3	Cr75Ta25 (400Å)	Cr59Ni40W1 (400Å)	Cr (600Å)	Co83.5Cr10.5Ta6 (250Å)	C (120Å)
4	Cr75Nb15N10 (400Å)	Cr59Ni40W1 (400Å)	Cr (600Å)	Co83.5Cr10.5Ta6 (250Å)	C (120Å)
5	Cr76Ta15N9 (400Å)	Cr57Ni42Ta1 (400Å)	Cr (600Å)	Co83.5Cr10.5Ta6 (250Å)	C (120Å)
11	Cr51Ni40N9 (800Å)	-----	Cr (600Å)	Co83.5Cr10.5Ta6 (250Å)	C (120Å)
12	-----	Cr58Ni40W2 (800Å)	Cr (600Å)	Co83.5Cr10.5Ta6 (250Å)	C (120Å)

[0020] The record reproducing characteristics of sample offering magnetic-recording data medium by which record reproducing-characteristics production was carried out were measured. In addition, since record reproducing characteristics also differed when magnetic properties differ, it measured by adjusting the coercive force Hc and the residual magnetic flux density Brd of each magnetic-recording data medium, respectively so that it may be set to 2400Oe and 210Gu. Measurement of record reproducing characteristics uses the PHS arm head made from Silmag, and is track-recording-density 120kFCI (k flux change per inch) **********. SNm shows the noise of data medium, and the ratio of signal strength among a table 2, and Nm shows the noise of data medium. Moreover, among a table 2, NLTS is the abbreviation of Non Linear Transition Shift, and as a result of the stray magnetic field on the already written-in record pattern affecting the record magnetic field of an arm head, it expresses the amount from which the location of the magnetization transition region written in a disk next shifts.
[0021]
[A table 2]

No	非晶質層	結晶質層	磁気特性		記録再生特性		
			Hc (Oe)	Brd (Gu)	SNm (dB)	Nm (μVrms)	NLTS (%)
1	Cr57Ni37Mo4	Cr58Ni40W2	2400	209	31.1	1.98	3.31
2	Cr51Ni40N9	Cr60Ni40	2390	205	32.5	1.85	3.23
3	Cr75Ta25	Cr59Ni40W1	2380	208	30.9	2.03	3.56
4	Cr75Nb15N10	Cr59Ni40W1	2430	210	30.7	2.12	3.57
5	Cr76Ta15N9	Cr57Ni42Ta1	2390	207	31.4	1.94	3.41
11	Cr51Ni40N9	-----	2350	205	29.3	2.58	4.18
12	-----	Cr58Ni40W2	2370	210	28.5	2.89	4.08

[0022] When a table 2 is referred to, it turns out that each magnetic-recording data-medium No.1-No.5 of this invention which carried out laminating membrane formation of both an amorphous layer (3) and the crystalline substance layer (4) has

magnetic-recording data-medium No.11 which formed either the amorphous layer (3) or the crystalline substance layer (4), and the record reproducing characteristics superior to No.12. Especially magnetic-recording data-medium No.2 have the record reproducing characteristics superior to other magnetic-recording data medium of this invention. Thus, magnetic-recording data-medium No.1-No.5 of this invention compare with magnetic-recording data-medium No.11 which have the amorphous layer (3) or crystalline substance layer (4) of a monolayer, and No.12. Having outstanding record reproducing characteristics by the amorphous layer (3) and crystalline substance layer (4) which carried out laminating membrane formation between the substrate (2) and the substrate layer (5) + (211) orientation which is the main crystal orientation of Cr alloy which constitutes a substrate layer (5) (110) improves. As a result, it is for the orientation which is the main crystal orientation of Co alloy which constitutes the magnetic layer (6) formed on it (100) to improve. It is because the crystal of a substrate layer (5) is made detailed by coincidence, as a result the crystal of a magnetic layer (6) is made detailed compared with magnetic-recording data-medium No.11 which have the amorphous layer (3) or crystalline substance layer (4) of a monolayer, and No.12.
[0023] coercive force -- next, among above-mentioned sample offering magnetic-recording data medium, about No.1, No.11, and No.12, the thickness of the magnetic layer (6) of Co alloy which forms membranes on a substrate layer (5) was changed, and coercive force was measured, respectively. A result is shown in drawing 2 . Even if magnetic-recording data-medium No.1 of this invention which carried out laminating membrane formation of both an amorphous layer (3) and the crystalline substance layer (4) is the magnetic layer (6) of which thickness, magnetic-recording data-medium No.11 which formed either the amorphous layer (3) or the crystalline substance layer (4), and No.12 show that the high coercive force Hc is shown, so that clearly from drawing 2 . It is based on detailed-ization like the above with improvement in the crystal orientation of a substrate layer (5) and a magnetic layer (6) that magnetic-recording data-medium No.1 of this invention has high coercive force compared with magnetic-recording data-medium No.11 and No.12. In addition, there is the improvement effect of coercive force similarly about magnetic-recording data-medium No.2-No.5.
[0024] The external magnetic field where magnitude differs to magnetic-recording data medium using an oscillatory type sample magnetometer (VSM) about deltaM measurement sample offering magnetic-recording data-medium No.1, No.11, and No.12 was added, and "deltaM" which shows the magnitude of the magnetic interaction between Co magnetic particles was measured. The positive maximum of deltaM shows the magnitude of the magnetic interaction between Co magnetic particles, and is said for the magnetic interaction of magnetic particles to be so large that the positive maximum of deltaM be large, and to be easy to generate a data-medium noise. Conversely, if the positive maximum of deltaM is small, the magnetic particle is isolated magnetically, respectively and is said to be able to suppress generating of the data-medium noise by the magnetic interaction between magnetic particles.
[0025] The result of deltaM measurement is shown in drawing 3 . When drawing 3 is referred to, magnetic-recording data-medium No.1 of this invention is understood that the positive maximum of deltaM is small compared with magnetic-recording data-medium No.11 and No.12. That is, Co magnetic particle in a magnetic layer is isolated magnetically, respectively, and the data-medium noise by the magnetic interaction between magnetic particles cannot generate magnetic-recording data-medium No.1 easily. That the positive maximum of deltaM of magnetic-recording data-medium No.1 of this invention became small! It is because the segregation to the grain boundary of Cr was fully promoted and magnetic isolation of Co magnetic particle was achieved between the substrate (2) and the substrate layer (5) in the magnetic layer (6) which consists of Co-Cr-Ta by having carried out laminating membrane formation of an amorphous layer (3) and the crystalline substance layer (4) at the duplex. Compared with this, since the maximum of deltaM positive in 12 is large, in magnetic-recording data-medium No.11 which formed the amorphous layer (3) or the crystalline substance layer (4) by the monolayer, and No. magnetic layer (6), the segregation to the grain boundary of Cr is not fully promoted, but Co magnetic particle is considered not to be isolated enough [magnetic], respectively.
[0026] In addition, reduction of the magnetic interaction of Co magnetic particle can be similarly aimed at about magnetic-recording data-medium No.2-No.5, and magnetic isolation of Co magnetic particle can be attained.

[Translation done.]